OIPE IAP52
APR 27 2006
PATENT & TRADEMARK OFFICE

10/682620

PTO/SB/21 (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

		Application Number	Patent#: 7029171
		Filing Date	Issued: April 18, 2006
		First Named Inventor	Davide Tesi
		Art Unit	2859
		Examiner Name	G. K. Verbitsky
Total Number of Pages in This Submission	12	Attorney Docket Number	S1022.81094US00

ENCLOSURES (*Check all that apply*)

☐ Fee Transmittal Form	☐ Drawing(s)	☐ After Allowance Communication to TC
☐ Fee Attached	☐ Licensing-related Papers	☐ Appeal Communication to Board of Appeals and Interferences
☐ Amendment/Reply	☐ Petition	☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
☐ After Final	☐ Petition to Convert to a Provisional Application	☐ Proprietary Information
☐ Affidavits/declaration(s)	☐ Power of Attorney, Revocation Change of Correspondence Address	☐ Status Letter
☒ Copy of Page 4 of Apl as Filed	☐ Terminal Disclaimer	☐ Other Enclosure(s) (please Identify below):
☒ Request for Certificate of Correction	☐ Request for Refund	Return Post Card
☒ Certificate of Correction	☐ CD, Number of CD(s) ____	
☒ Copy of Declaration and Power of Attorney/Copy of Filing Receipt	☐ Landscape Table on CD	
☐ Copy of Title Page and Column 3 of U.S. 7,029,171	Remarks	Certificate MAY 01 2006 of Correction
☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	WOLF, GREENFIELD & SACKS, P.C.		
Signature			
Printed name	James H. Morris		
Date	April 25, 2006	Reg. No.	34,681

Certificate of Mailing Under 37 CFR 1.8(a)

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as First Class Mail, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: April 25, 2006

Signature: _____ (Gail Driscoll)

MAY 2 2006

CIPE IAP52
APR 27 2006
PATENT & TRADEMARK OFFICE

Docket No.: S1022.81094US00
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Davide Tesi Ugo Zampieri
Serial No.:	10/682620
Confirmation No.:	8428
Filed:	October 9, 2003
Patent No.:	7029171
For:	INTEGRATED DIGITAL TEMPERATURE SENSOR
Examiner:	Gail K. Verbitsky
Art Unit:	2859

Certificate of Mailing Under 37 CFR 1.8(a)
I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as First Class Mail, in an envelope addressed to: Attention: Certificate of Correction Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: April 25, 2006

Gail Driscoll

REQUEST FOR CERTIFICATE OF CORRECTION
PURSUANT TO 37 CFR 1.322

Attention: Certificate of Correction Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Upon reviewing the above-identified patent, Patentee noted typographical errors which should be corrected.

On the Title Page:

The residence of the second named inventor, Ugo Zampieri is incorrect. The correct residential address for Mr. Zampieri is Saint Genis Pouilly (FR)

In the Specification:

At page in column 3, line 24 the word "is" has been inserted into text of issued U.S. Patent No. 7,029,171. The word "is" was not part of the application as filed and no amendment was made by either the Examiner or Patentees to incorporated this change.

The corrections requested do not involve change in the patent that constitutes new matter or would require reexamination. Therefore, it is respectfully requested that the correction be made and that a Certificate of Correction be issued.

In support of the above, Patentee encloses a highlighted copy of page 4 of the application as filed, the Declaration and Power of Attorney, Filing Receipt and the title page and column 3 of issued U.S. Patent No. 7,029,171 B2. Also enclosed is a Certificate of Correction form PTO Form SB/44.

Since neither of the above amendments were made by either Patentees or the Examiner it is respectfully requested that the corrections as specified herein and on the attached Certificate of Correction, PTO form SB/44 be made and a Certificate of Correction be granted. Patentees respectfully submit that, since the errors for which a Certificate of Correction is sought was the result of Patent Office mistake, no fee is due. However, if the Examiner deems a fee necessary, the fee may be charged to the account of the undersigned, Deposit Account No. 23/2825.

Transmitted herewith is a proposed Certificate of Correction effecting such amendment. Patentees respectfully solicit the granting of the requested Certificate of Correction.

Dated: April 25, 2006

Respectfully submitted,

By: _____

James H. Morris
Registration No.: 34,681
WOLF, GREENFIELD & SACKS, P.C.
Federal Reserve Plaza
600 Atlantic Avenue
Boston, Massachusetts 02210-2206
(617) 646-8000

MAY 2 2006

OIPE IAP52
APR 27 2006
PATENT & TRADEMARK OFFICE

Declaration and Power of Attorney for Patent Application

Déclaration et Pouvoirs pour Demande de Brevet

French Language Declaration

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que:

As a below named inventor, I hereby declare that:

Mon domicile, mon adresse postale, et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

My residence, post office address and citizenship are as stated next to my name.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

INTEGRATED DIGITAL TEMPERATURE SENSOR

et dont la description est fournie ci-joint à moins que la case suivante n'ait été cochée:

the specification of which is attached hereto unless one of the following boxes is checked:

- ☐ a été déposée le _____ sous le numéro de demande des Etats-Unis ou le numéro de demande international PCT _____
- ☐ was filed on _____ as United States Application Number or PCT International Number _____
- ☐ les specifications portant le dossier de l'avocat numero _____ et modifiée le _____ (le cas échéant).
- ☐ the specification of which bears attorney docket No. _____ and was amended on _____ (if applicable).

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises, telles que modifiées par toute modification dont il aura été fait référence ci-dessus.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, §1.56 du Code fédéral des réglementations.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

MAY 2 2006

French Language Declaration

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, §119(a)-(d) ou § 365(b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35, § 365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

Prior foreign application(s)
Demande(s) de brevet antérieure(s)

(Number) (Numéro)	(Country) (Pays)	Priority not claimed Droit de priorité non revendiqué
02/12552	FRANCE	
9 OCTOBER 2002 (Day/Month/Year Filed) (Jour/Mois/Année de dépôt)		☐
		☐

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35 §119(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

(Application No.) (N° de demande)	(Filing Date) (Date de dépôt)

Je revendique par le présent acte, le bénéfice, en vertu du Titre 35 § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code Fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande:

(Application No.) (N° de Demande)	(Filing Date) (Date de Dépôt)

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby claim foreign priority under Title 35, United States Code, §119(a)-(d) or § 365(b) of any foreign applications(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or § 365(c) of any PCT international application(s) designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Status)(Patented, pending abandoned) (Statut)(breveté, en cours d'examen, abandonné)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

French Language Declaration

POUVOIR: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu''il(s) poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques comme defini par le numéro d'enregistrement du cabinet

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith as defined by Customer Number

23628

et les avocats et/ou agents suivants:

and the Practitioners named below:

Lisa K. Jorgenson, Reg. No. 34,845
Mario J. Donato, Jr, Reg. No.. 37,816
Nainesh Shah, Reg. No. 40,166

Adresser toute correspondance à:

Address correspondence to:

James H. Morris
Wolf, Greenfield & Sacks, P.C,
Federal Reserve Plaza
600 Atlantic Avenue, Boston, MA 02210-2211(USA)

Adresser tout appel téléphonique à: *(Nom et numéro de téléphone)*

Direct Telephone Calls to: (name and telephone number)

James H. Morris
(617) 720-3500

Nom complet de l'unique ou premier inventeur TESI Davide	Full name of sole or first inventor
Signature de l'inventeur Date TESI Davide 17-09-03	Inventor's signature Date
Domicile 01210 FERNEY-VOLTAIRE,	Residence
Nationalité ITALIAN	Citizenship
Adresse Postale 10, Chemin du Mont-Blanc	Post Office Address
Nom complet du second co-inventeur, le cas échéant ZAMPIERI Ugo	Full name of second or joint inventor
Signature de l'inventeur Date Zampieri Ugo 17-09-03	Inventor's signature Date
Domicile 01630 SAINT GENIS POULLY,	Residence
Nationalité ITALIAN	Citizenship
Adresse Postale 3 Bis, Chemin du Moulin des Ponts	Post Office Address
(Fournir les mêmes renseignements et la signature de tout co-inventeur supplémentaire.)	(Supply similar information and signature for third and sub-sequent joint inventors.)

MAY 2 2006

LEA

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPL NO.	FILING OR 371 (c) DATE	ART UNIT	FIL FEE REC'D	ATTY.DOCKET NO	DRAWINGS	TOT CLMS	IND CLMS
10/682,620	10/09/2003	2816	942	S1022.81094US00	3	15	5

CONFIRMATION NO. 8428

CORRECTED FILING RECEIPT

OC000000011948998

23628
WOLF GREENFIELD & SACKS, PC
FEDERAL RESERVE PLAZA
600 ATLANTIC AVENUE
BOSTON, MA 02210-2211

CIPE IAP52 APR 27 2006 PATENT & TRADEMARK OFFICE

Date Mailed: 02/23/2004

Receipt is acknowledged of this regular Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections, facsimile number 703-746-9195. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

Applicant(s)

Davide Tesi, Ferney-Voltaire, FRANCE;
Ugo Zampieri, Saint Genis Pouilly, FRANCE;

S1022.81094US00
Initials
Confirmation ☐
Docketing ☑
ATHM/LEA

Domestic Priority data as claimed by applicant

Foreign Applications

FRANCE 02/12552 10/09/2002

If Required, Foreign Filing License Granted: 01/08/2004

Projected Publication Date: 04/15/2004

Non-Publication Request: No

Early Publication Request: No

DOCKETED
FEB 26 2004

Title

Integrated digital temperature sensor

Preliminary Class

MAY 2 2006

327

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Office of Export Administration, Department of Commerce (15 CFR 370.10 (j)); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

MAY 2 2006

US007029171B2

(12) **United States Patent**
Tesi et al.

(10) **Patent No.: US 7,029,171 B2**
(45) **Date of Patent: Apr. 18, 2006**

(54) **INTEGRATED DIGITAL TEMPERATURE SENSOR**

(75) Inventors: **Davide Tesi**, Ferney-Voltaire (FR); **Ugo Zampieri**, Saint Genis Poully (FR)

(73) Assignee: **STMicroelectronics S.A.**, Montrouge (FR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/682,620**

(22) Filed: **Oct. 9, 2003**

(65) **Prior Publication Data**

US 2004/0071183 A1 Apr. 15, 2004

(30) **Foreign Application Priority Data**

Oct. 9, 2002 (FR) 02 12552

(51) **Int. Cl.**
G01K 15/00 (2006.01)
G01K 7/01 (2006.01)
G01K 7/14 (2006.01)

(52) **U.S. Cl.** **374/1**; 374/178; 702/130; 702/99; 327/513

(58) **Field of Classification Search** 374/1, 374/170, 173, 178; 327/512, 513; 702/99, 702/130, 133, 131
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,921,453 A * 11/1975 Platzer, Jr. 374/181
4,165,642 A * 8/1979 Lipp 374/170
4,227,185 A * 10/1980 Kronlage 341/167
4,313,083 A * 1/1982 Gilbert et al. 323/350
4,475,103 A * 10/1984 Brokaw et al. 340/501
4,562,554 A * 12/1985 Stixrud et al. 712/36
4,583,009 A * 4/1986 Eng, Jr. 327/540
5,153,500 A 10/1992 Yamamoto et al.
5,304,861 A 4/1994 Fruhauf et al.
5,357,149 A * 10/1994 Kimura 327/512
5,471,131 A 11/1995 King et al.
5,485,127 A 1/1996 Bertoluzzi et al.
5,629,611 A 5/1997 McIntyre
5,646,518 A 7/1997 Lakshmikumar et al.
5,822,225 A * 10/1998 Quaderer et al. 702/89
5,900,773 A 5/1999 Susak
5,961,215 A * 10/1999 Lee et al. 374/178
5,982,221 A * 11/1999 Tuthill 327/512
6,008,685 A * 12/1999 Kunst 327/512
6,255,891 B1 7/2001 Matsuno et al.

(Continued)

OTHER PUBLICATIONS

French Search Report from French Patent Application No. 02/12552, filed Oct. 9, 2002.

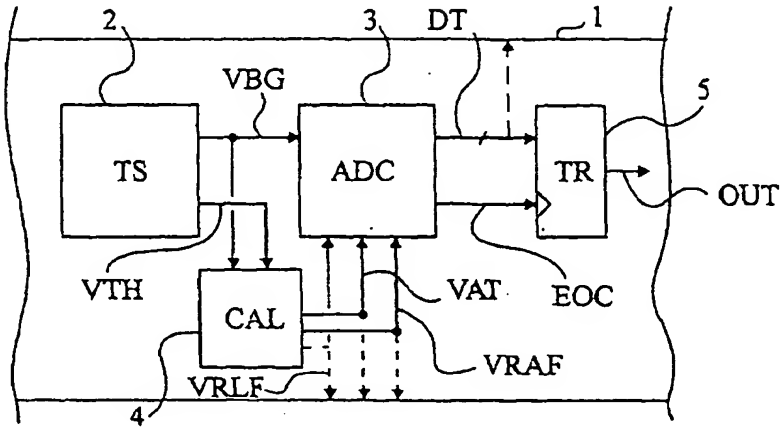
(Continued)

Primary Examiner—Gail Verbitsky
(74) *Attorney, Agent, or Firm*—Lisa K. Jorgenson; James H. Morris; Wolf, Greenfield & Sacks, P.C.

(57) **ABSTRACT**

A digital integrated circuit temperature sensor including an analog-to-digital converter providing a binary word representative of a temperature internal to the integrated circuit, and a circuit for providing an analog voltage representative of the circuit temperature and for generating a reference voltage for the analog-to-digital converter. The present invention especially applies to the testing of integrated circuits and to the control of their frequency and/or of their operating temperature according to their internal temperature.

5 Claims, 3 Drawing Sheets



MAY 2 2006

elements between the output terminal of the first amplifier and the reference voltage; and

a second operational amplifier having an inverting input terminal receiving the analog voltage depending on temperature and having a non-inverting input connected to the midpoint of its two resistive elements series-connected between the output terminal of said second operational amplifier and the reference voltage, the second operational amplifier providing an amplified voltage to be converted by said analog-to-digital converter.

According to an embodiment of the present invention, said variable resistive elements are formed of networks of switchable resistors.

The present invention also provides an integrated circuit comprising a digital temperature sensor and a JTAG port of communication with the outside of the circuit, an input/output register of the integrated circuit being connected to a register for memorizing the result provided by the analog-to-digital converter.

The present invention also provides an integrated circuit comprising a digital temperature sensor and a logic block of interpretation of the current temperature measured by the sensor to control the frequency and/or the supply voltage of the is integrated circuit.

The present invention also provides a method for controlling the clock frequency of a digital integrated circuit, consisting of varying the clock frequency in a way inversely proportional to the internal temperature of the circuit.

The present invention further provides a method for controlling the supply voltage of a digital integrated circuit, consisting of varying the supply voltage in a way inversely proportional to the internal circuit temperature.

According to an embodiment of the present invention, the temperature is measured by means of an integrated sensor.

The foregoing objects, features, and advantages of the present invention will be discussed in detail in the following non-limiting description of specific embodiments in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** partially shows in the form of blocks an embodiment of a digital thermal sensor according to the present invention;

FIG. **2** shows the electric diagram of a sensor of a voltage varying along with temperature according to an embodiment of the present invention;

FIG. **3** shows a first embodiment of circuit for calibrating a sensor according to the present invention;

FIG. **4** shows an embodiment of a circuit for activating the voltage sensor of FIG. **2**;

FIG. **5** partially illustrates in the form of blocks a first example of application of the present invention to the testing of an integrated circuit;

FIG. **6** partially illustrates in the forms of blocks a second example of application of the present invention to the control of an operating frequency and/or of a supply voltage of an integrated circuit according to its internal temperature; and

FIG. **7** very schematically shows a second embodiment of a circuit for calibrating the sensor of FIG. **1**.

DETAILED DESCRIPTION

Same elements have been designated with same reference numerals in the different drawings. For clarity, only those elements that are necessary to the understanding of the present invention have been shown in the drawings and will be described hereafter. In particular, the other components of the circuit on which the sensor of the present invention is integrated have not been detailed and are no object of the present invention. The present invention applies whatever the integrated circuit type and the functions that it integrates.

FIG. **1** partially shows in the form of blocks an embodiment of a digital thermal sensor, integrated in a circuit **1** according to the present invention.

This thermal sensor essentially comprises a circuit **2** (TS) forming a sensor of an analog voltage V_{TH} varying along with the integrated circuit temperature, an analog-to-digital converter **3** (ADC) for transforming an analog voltage varying along with temperature into a digital word DT representative of the measured temperature, and a circuit **4** (CAL) for calibrating converter **3**.

According to the present invention and as will be seen hereafter in more specific relation with FIG. **2**, measurement circuit **2** provides not only a voltage V_{TH} indicative of temperature but also a reference voltage V_{BG} for the analog-to-digital conversion. Voltage V_{BG} is, for example, provided to calibration circuit **4** as well as to converter **3**.

The function of calibration circuit **4** is to amplify signal V_{TH} into an analog signal V_{AT} acceptable at the input of converter **3** and to set two thresholds V_{RLF} and V_{RHF} defining the conversion range of the converter, that is, an analog voltage V_{RLF} for which converter **3** provides a signal DT only comprised of bits at zero and an analog voltage V_{RHF} for which converter **3** only provides bits at one. Low threshold V_{RLF} of converter **3** preferentially corresponds to reference voltage V_{BG}. This is why, in the representation of FIG. **1**, said voltage is directly transmitted from circuit **2** to converter **3**.

Converter **3** is an analog-to-digital converter of conventional structure. In particular, it preferably provides a signal EOC indicative of the end of a conversion after reception of a signal V_{AT} to be converted, generally under control of a start-of-conversion signal SOC (not shown).

In the preferred embodiment of FIG. **1**, signal EOC is connected to a clock input of a register **5** (TR) for storing temperature DT provided by converter **3** at each conversion. Output OUT of register **5** is then exploited according to the desired application.

As illustrated by the dotted lines in FIG. **1**, current temperature DT may, if desired, be directly provided on an input/output port of circuit **1**. Similarly, voltages V_{RLF} and V_{RHF} representative of the converter's operating range as well as analog voltage V_{AT} to be converted may be provided on external access terminals of integrated circuit **1**.

FIG. **2** shows the electric diagram of a preferred embodiment of analog sensor **2** of FIG. **1**. In FIG. **2**, the sensor is only partially shown. In particular, an activation circuit thereof will be described subsequently in relation with FIG. **4**.

According to the present invention, the circuit of FIG. **2** forms both an element of detection of the internal temperature of the integrated circuit and a circuit for generating reference voltage V_{BG} of bandgap type used by calibration circuit **4** of the converter.

The circuit of FIG. **2** comprises a first branch comprising a PNP-type bipolar transistor **10**, diode-connected between two terminals **11** and **12** of the sensor. A terminal **11** is connected to the emitter of transistor **10** while its base and its collector are interconnected to a terminal **12** intended to be connected to a rail of low voltage reference supply V_{SS} of the integrated circuit (generally the ground).

analog voltage depending on temperature and having a non-inverting input connected to the midpoint of its two resistive elements series-connected between the output terminal of said second operational amplifier and the reference voltage, the second operational amplifier providing an amplified voltage to be converted by said analog-to-digital converter.

According to an embodiment of the present invention, said variable resistive elements are formed of networks of switchable resistors.

The present invention also provides an integrated circuit comprising a digital temperature sensor and a JTAG port of communication with the outside of the circuit, an input/output register of the integrated circuit being connected to a register for memorizing the result provided by the analog-to-digital converter.

The present invention also provides an integrated circuit comprising a digital temperature sensor and a logic block of interpretation of the current temperature measured by the sensor to control the frequency and/or the supply voltage of the integrated circuit.

The present invention also provides a method for controlling the clock frequency of a digital integrated circuit, consisting of varying the clock frequency in a way inversely proportional to the internal temperature of the circuit.

The present invention further provides a method for controlling the supply voltage of a digital integrated circuit, consisting of varying the supply voltage in a way inversely proportional to the internal circuit temperature.

According to an embodiment of the present invention, the temperature is measured by means of an integrated sensor.

The foregoing objects, features, and advantages of the present invention will be discussed in detail in the following non-limiting description of specific embodiments in connection with the accompanying drawings.

Brief Description Of The Drawings

Fig. 1 partially shows in the form of blocks an embodiment of a digital thermal sensor according to the present invention;

Fig. 2 shows the electric diagram of a sensor of a voltage varying along with temperature according to an embodiment of the present invention;

2006

PTO/SB/44 (04-05)
Approved for use through 04/30/2007. OMB 0651-0033
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO.	:	7029171
APPLICATION NO.	:	10/682620
ISSUE DATE	:	April 18, 2006
INVENTOR(S)	:	Davide Tesi and Ugo Zampieri

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page, Item (75) should read:
Inventors: Daivde Tesi, Ferney-Voltaire (FR); Ugo Zampieri, Saint Genis Pouilly (FR)

Col. 3, line 24 should read:
the integrated circuit.

MAILING ADDRESS OF SENDER (Please do not use customer number below):
James H. Morris
WOLF, GREENFIELD & SACKS, P.C.
Federal Reserve Plaza
600 Atlantic Avenue
Boston, Massachusetts 02210-2206